UNITED PLANTERS' ASSOCIATION OF SOUTHERN INDIA

TEA SCIENTIFIC SECTION

ANNUAL ADMINISTRATION REPORT

FOR

1949-50

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UNITED PLANTERS' ASSOCIATION OF SOUTHERN INDIA

ANNUAL REPORT OF THE U. P. A. S. I. TEA SCIENTIFIC SECTION 1949–50

1. Staff.—Mr. P. de Jong assumed the appointment of Chief Tea Scientific Officer on 1st October 1949.

Mr. S. Ananda Rau continued in his capacity of Assistant Tea Scientific Officer and Officer-in-Charge of the Devarshola Experiment Station.

Mr. K. S. Venkataramani, Botanist, was awarded the degree of Doctor of Philosophy by the Madras University.

2. Administration.—The Chief Tea Scientific Officer retained his headquarters at Glenview, Coonoor, and established an office there to deal with matters of administration affecting the Section.

Official visits to the Station were carried out by Mr. W. A. L. Marr, M.B.E., appointed for the purpose by the Tea Section Committee, in May, September and December 1949 and in March 1950. Reports on these visits were circulated to all Members of the Tea Section Committee.

3. Correspondence.—From the time of setting up office at Glenview the average amount of correspondence dealt with each month by the Chief Tea Scientific Officer was 70 receipts and 80 despatches, excluding reports. No clerk was maintained at Glenview.

At the Devarshola Station 1,192 letters were received and 1,125 despatched.

4. Scientific Sub-Committee.—A Scientific Sub-Committee comprising Messrs. W. I. Hatherell (Convener), K. J. H. Mackenzie and W. A. L. Marr (Members) was appointed by the Tea Section Committee in March 1950, to act as a link between the Tea Section Committee and the Tea Scientific Section and to form a body to which immediate reference on matters of Section policy, expenditure, touring, administration and similar matters, could easily be made.

The Sub-Committee had its first meeting at Glenview on 15th April 1950, when future policy of the Section and the question of equipping Devarshola Station were considered.

5. Buildings.—Repairs in connection with annual maintenance were executed on buildings at the Experiment Station. Repairs were carried out to the water supply head tank and ceiling boards were installed in the laboratory.

A new electric centrifugal water pump was installed and pump sheds were built to house both pump sets, the material for these buildings being obtained from that salvaged after the demolition of an old line.

Another vacant building was renovated and converted into quarters for one Laboratory Attender.

6. **Publications.**—The following Notes and articles were published during the period under review.

1. " A Note on a Leaf Disease of Rubber in S. India " by Dr. K. S. Venkataramani. (*Planters' Chronicle*, Vol. XLIV, No. 21, 1 November 1949).
2. " Report on the First Symposium on Blister Blight Control—Ceylon " by Peter de Jong. (*Planters' Chronicle*, Vol. XLIV, No. 23, 1 December 1949).
3. " The Inhibition of the Growth of Fungi by Certain Dyestuffs " by Dr. K. S. Venkataramani. (*Planters' Chronicle*, Vol. XLV, No. 1, 1 January 1950).
4. " Defoliation, a Disorder of Tea in S. India " by Peter de Jong. (*Planters' Chronicle*, Vol. XLV, Nos. 6 & 7, 15 March and 1 April 1950).
5. " An Instance of Polyembryony in Tea " by Dr. K. S. Venkataramani. (*Planters' Chronicle*, Vol. XLV, No. 7, 1 April 1950).
6. " Policy, Aims and Objects of the U.P.A.S.I. Tea Scientific Department " by Peter de Jong. (*Planters' Chronicle*, Vol. XLV, No. 12, 15 June 1950).
7. " Future Trends in Plant Protection " by Peter de Jong. (*Planters' Chronicle*, Vol. XLV, No. 13, 1 July 1950).

7. **Scientific Conference and Exhibition.**—As in 1948, a Scientific Conference was held at the time of the U.P.A.S.I., August Meetings, presided over by the President, U.P.A.S.I., Mr. F. G. Wallace.

The papers presented were :—

1. Tea and Coffee as Food—by Dr. V. N. Patwardhan, Director, Nutrition Research Laboratories, Coonoor.
2. Place of *Helopeltis* control in Tea economy—by Mr. S. Ananda Rau, Ag. Tea Scientific Officer, U.P.A.S.I.
3. Soil Problems of the Tea Industry—by Mr. N. G. Gokhale, Physical Chemist, Tocklai Experiment Station, Cinnamara, Assam.
4. Manuring of Coffee—by Mr. K. M. Thomas, Director of Research, Indian Coffee Board, Coffee Research Station, Balehonnur.
5. Potash Requirements of Tea—by Mr. G. B. Portsmouth, Plant Physiologist, Tea Research Institute, Ceylon.
6. The Application of the Scientific Method to Production Problems—by Mr. W. W. Mayne, Scientific Officer, K.D.H.P. Co., Ltd., Munnar.

A lively discussion followed the presentation of the papers.

Also, as in the previous year, the U.P.A.S.I. Exhibition, organised during the August Meetings proved a great attraction. The Exhibition lasted for four days and was enlarged in scope to cover all types of machinery, apparatus, equipment and supplies used in plantation work, whether in the field, the factory or the office. In addition such Institutions as the Government Agriculture Department, Nutrition Research Institute and the Government Silk Farm were represented, as was the Indian Coffee Board.

A programme of Demonstrations of various plant protection products and machines was also a feature of the exhibition.

8. Visitors.—During the period under review we were pleased to welcome a number of visitors to the Office at Glenview, Coonoor and to the Experiment Station.

Among those who visited the Station were Mr. B. St. J. Boultbee, Chairman, Tea Section Committee, Mr. W. W. Mayne, Scientific Officer, K.D.H.P. Co., Ltd., Mr. R. Coleman, Messrs. I.C.I. (India) Ltd., and a number of Superintendents and Managers of Estates.

We were also pleased to welcome colleagues from outside S. India.

In November 1949, Mr. J. H. Van Emden from the Botanical Division of the Experiment Station and Dr. J. Reitsma, Head of the Botanical Subdivision of the Government Institute for Phytopathological Research, both situated at Buitenzorg, Java, visited S. India and made a rapid tour of the Anamallais accompanied by the Scientific Officer.

In December 1949, Dr. T. Swarbrick, Director of Biological Research, Shell Chemicals, at the Hague, visited both Coonoor and Devarshola and accompanied the Scientific Officer to the Nilgiri-Wynaad and on a rapid visit to the High Range, where they were joined by Dr. R. M. Greenslade of Messrs. Pest Control, Ltd. Both Drs. Swarbrick and Greenslade addressed the Tea Section Committee at their meeting at Coonoor on 3rd December 1949.

9. Indian Council of Agricultural Research.—The Chief Tea Scientific Officer remained the U.P.A.S.I. representative on this Council but did not attend the meetings held in Patiala during March 1950.

10. Nilgiri District Soil Conservation Board.—The Chief Tea Scientific Officer took over the U.P.A.S.I. representation on this Board from Mr. J. McBride in November 1949. He also served as a member of the Sub-Committee responsible for drafting legislation relating to Soil Conservation measures to be adopted on the Nilgiris and attended the quarterly and interim meetings of the Board.

11. Government Botanic Gardens, Ootacamund.—The Chief Tea Scientific Officer acted as Convener of the Plantations Exhibit Committee in connection with the Centennial Celebrations of the Government Botanic Gardens, Ooty, in May 1950. An exhibit showing the scope of the plantation industries on the Nilgiris was arranged and a paper, " Tea on the Nilgiris ", was read during the meetings.

12. Touring.—Initially, considerable difficulty was encountered in obtaining adequate supplies of petrol for touring purposes, but representations to the Home Department, Government of Madras, were partly successful and increased allocations were received in 1950 which helped to ease the position.

The importance of touring cannot be overemphasised and the Tea Section Committee have considered the question of providing the Asst. Scientific Officer with a loan to cover the cost of purchase of a car for touring and have recently agreed to such a loan being made and also to the provision of the customary Travelling Allowances.

In addition to a number of visits to Estates on the Nilgiris and Nilgiri-Wynaad in connection with field experiments and advisory matters, the following tours were carried out by the Chief Tea Scientific Officer.

(*a*) To Ceylon in November 1949 to attend the first Symposium on Blister Blight held at Nuwara Eliya. An opportunity was taken to visit the Tea Research Institute, Ceylon and a number of Estates in the locality.

(*b*) In November 1949, in company with Messrs. Van Emden and Reitsma to the Anamallais to study the effects of Blister Blight in that area.

(*c*) In December 1949 in company with Drs. Swarbrick and Greenslade to the High Range to study the effects of Blister Blight.

(*d*) In January 1950 to Madras to attend the All India Meetings of the Agr. Economics Society of India and to Poona to attend the Annual Meeting of the Indian Science Congress.

(*e*) In February 1950 to Quilon and the Mundakayam area in company with Mr. R. Coleman of Messrs. I.C.I. (India) Ltd.

The Asst. Tea Scientific Officer carried out the following visits in addition to visits to local estates on advisory matters.

(*a*) Visit to Central Travancore in September/October 1949 in connection with *Helopeltis* control.

(*b*) Visit to Assam in October 1949 primarily with the object of studying *Helopeltis* and its control in N.E. India.

(*c*) Visit to Ceylon in November 1949 to attend the Symposium on Blister Blight.

13. Field Experiments.—The Field Experiments reported upon in previous years have been continued. The results are referred to in detail later in this report.

It has been decided to discontinue some of these experiments as the results suggest that there is nothing to be gained by their continuance. A new experiment on response to Nitrogen is being laid out at Korakundah in place of the present trial, the results of which are prejudiced by the presence of heavy leguminous shade on the experimental area.

A small scale experiment into the possibility of dusting tea in plucking as a control measure for Blister Blight has been laid out on Mayfield Estate and will be referred to in another place in this report.

14. Manuring.—During the year under review, the response to potash mentioned in last year's report became more marked in the manurial experiment now running its tenth year. Even the lower level of application, *viz.*, 20 lbs. K per acre, gave significant increase in yield over no potash. This finding demonstrates in some measure the inadvisability of omitting potash in manure mixtures, especially in view of the observed correlation between defoliation and omission of potash.

From advice sought during the year on manurial problems, a few points have emerged which it might be of some interest to mention here. One is the advisability of continuous use of Sulphate of Ammonia in view of the possible risk of increasing the acidity of an already highly acid soil. While it is true that Sulphate of Ammonia tends to increase soil acidity, a marked increase may take place only after continuous use over a number of years. Should this be feared, it is suggested that Calcium Cyanamide, if available

be alternated with Sulphate of Ammonia or lime applied at the rate of about 10 cwts. per acre once in 8 or 10 years. Either of these measures should help to keep the soil reaction at its original level. Alternatively Ammonium Nitrate may be used in place of Sulphate of Ammonia.

Another question often asked is whether it is necessary to manure soils which are rich in organic matter and nitrogen. It should be emphasised that under conditions of tea cultivation the soils are not likely to maintain their initial fertility and it is advisable therefore to follow a regular manuring policy consistent, of course, with the economic returns accruing from manuring.

Manuring of tea areas in which ' defoliation ' symptoms have become prominent is yet another problem confronting Estates which are subject to this disorder. The problem is a complicated one, but all available evidence points to the inutility or only partial utility of manuring. It is considered that light treatment, resting and measures to improve the soil moisture status during the dry weather should receive first attention with a view to rehabilitate the bushes in such areas before they can make the maximum use of the added manure.

15. Pests and Diseases.—As indicated in previous reports, the importance of research into control measures for the principal pests and diseases of tea has in no way diminished.

The problem of *Helopeltis* attack is now largely under control and DDT dusting is fast becoming an established practice in the affected areas. Work is still required on certain aspects, such as the possibility of the origin of a DDT-resistant strain of *Helopeltis* and a build up of Mite population consequent upon the use of DDT dusts and sprays and these problems are under consideration. Certain new insecticides and insecticidal complexes are now in production and their possible application to the *Helopeltis* problem is being studied. Problems associated with mixing and ' separation ' have been largely overcome by producers who are now marketing ready mixed 3, 4 and 5% DDT Dusts and DDT of particle size matched with local fillers.

To a great extent research has centred on the problems of Blister Blight Control and ' Defoliation '. The latter problem has been established as a physiological disorder of tea consequent upon drought and, as such, lies outside the scope of chemical control. Future work on this problem will follow the lines of Soil Air/Moisture Relationship Studies and cultural methods to reduce the effects of drought, together with work on the selection and propagation of drought resistant varieties and methods to rehabilitate bushes suffering from drought damage.

Our work on Blister Blight centres at present on the possibility of treating tea in plucking in order to control the development of the fungus. Basing our approach to the problem on experience gained in the field against *Helopeltis*, investigations are proceeding with a specially formulated copper fungicide in dust form. Pilot experiments to discover the effect of the fungicide on the quality of manufactured tea, the toxic hazard and the fungicidal efficiency of the dust have been laid out on Mayfield Estate and dusting has been in progress since the end of March 1950.

Trials of other possible formulations are also being undertaken and are reported more fully elsewhere.

16. Acknowledgements.—Once again it gives great pleasure to record our appreciation of assistance and co-operation from members of the Tea

Section Committee and Scientific Sub-Committee and the Secretary and Staff of the U.P.A.S.I. Head Office at Coonoor.

We are also indebted to the Agents and Managers of Estates for the Co-operation given in the conduct of field experiments and especially to those from whom the staff have received so much help and hospitality whilst on tour.

We desire to acknowledge with gratitude help on technical matters received from time to time from the staffs of the Indian Agricultural Research Institute, New Delhi, the Agricultural Research Institute, Coimbatore and the Department of Botany, University of Madras.

Acknowledgement is also made of help received from numerous commercial undertakings in the preparation and supply of a variety of plant protection formulations.

In conclusion we wish to acknowledge the assistance of the Director and Staff of the Tea Research Institute of Ceylon and the Chief Scientific Officer and Staff of the I.T.A. Research Station, Tocklai, so kindly extended from time to time.

PETER DE JONG,
Chief Tea Scientific Officer.

METEOROLOGICAL

(1949–50)

Months.	Rainfall in inches	No. of days with rain	Air		Soil*		Humidity		Vapour pressure		Cloud	
			Average noon maximum	Average overnight minimum	8.30 A.M.	3.00 P.M.	8.30 A.M.	3.00 P.M.	8.30 A.M.	3.00 P.M.	8.30 A.M.	3.00 P.M.
April 1949	3.98	16	84.3	64.6	79.6	92.0	85.5	64.6	22.4	22.8	—	—
May ,,	11.07	20	79.2	65.9	78.3	86.2	90.5	80.7	23.2	23.9	4.8	5.8
June ,,	12.15	29	75.4	64.7	73.2	79.2	87.0	88.2	21.4	23.0	6.2	6.4
July ,,	19.11	31	74.0	64.4	72.7	80.9	94.0	87.2	21.9	22.7	6.5	6.6
August ,,	10.24	27	74.5	64.3	73.3	78.2	92.8	88.4	21.8	23.3	5.9	6.4
September,,	7.42	26	75.1	63.7	72.6	77.8	89.6	85.2	21.1	22.4	3.0	7.3
October ,,	8.06	26	77.5	63.8	73.1	79.6	93.8	84.8	22.0	23.7	5.1	5.2
November,,	0.82	3	77.9	60.4	70.6	80.0	80.2	55.9	17.8	16.6	4.5	3.3
December ,,	...	...	78.8	56.8	69.0	80.0	83.5	37.5	16.1	12.0	...	...
January 1950	...	...	80.2	56.6	69.5	80.7	89.3	42.2	16.4	14.0	3.0	4.3
February ,,	1.00	5	82.5	60.5	72.8	84.5	90.3	56.2	18.9	17.4	7.8	5.1
March ,,	1.04	3	85.1	62.3	78.6	93.7	83.7	50.5	20.6	19.3	4.0	3.9
Total ...	74.89	186										

*at 1 foot depth.

The rainfall for the year was about normal, but the rains ended towards the end of October and North-East monsoon was a total failure. This resulted in a drought of exceptional severity which was the third in succession. A few light showers were received in February and March, but these hardly sufficed to break the drought. Tea suffered rather badly towards the end of the year.

REPORT OF THE ASST. TEA SCIENTIFIC OFFICER AND ENTOMOLOGIST

(1949–50)

1. Administration.—I acted as the Tea Scientific Officer from the beginning of the year to end of September 1949 when the new Tea Scientific Officer arrived. I continued to remain in charge of the Devarshola Station throughout the year.

The activities of the Station and the administrative details such as the maintenance of buildings, additions and alterations made during the year, water supply, etc., are referred to in the Chief Tea Scientific Officer's report.

2. Correspondence.—Letters received and despatched at the Station numbered 1,192 and 1,125 respectively. This marks a slight increase over those of the previous year despite the fact that the Chief Tea Scientific Officer dealt with part of the correspondence from his headquarters at Coonoor during the latter half of the year.

3. Touring.—The principal tours made by me were the following :—

(1) Visit to Central Travancore in September/October 1949 in connection with *Helopeltis* control.

(2) Visit to Assam in October 1949, mainly to gain first hand knowledge of the condition of *Helopeltis* there and the control measures adopted, and at the same time to study the work of the Tocklai Experiment Station.

(3) Visit to Ceylon in November 1949 to participate in the Symposium on Blister Blight organised by the Tea Research Institute of Ceylon. A paper on the present position of Blister Blight and its control in South India was read at the Symposium.

(4) Periodic visits to an Estate in the Nilgiris to study the condition of thrips damage to tea and to devise a suitable control measure.

In addition, several estates in the neighbourhood of the Station were visited from time to time in connection with experiments laid down there and general advisory work. Scientific visitors from Assam and Ceylon who had come to attend the August meetings were taken round a few estates in the Nilgiris.

4. Scientific Conference.—This was organised at the time of the Annual U.P.A.S.I. Conference. Among others, representatives of the Ceylon and Tocklai Research Institutes attended and participated in the Conference. A paper entitled " Place of *Helopeltis* control in Tea Economy " was read by me at the Conference.

5. U.P.A.S.I. Exhibition.—The Tea Scientific Department arranged a stall at the Exhibition in which specimens of common diseases and pests of tea, soils at different tea districts of S. India and charts and posters relating to manuring of tea were displayed. The stall attracted large attendance.

6. Advisory Work.—Considerable time had to be devoted to this aspect of work which naturally did not leave as much time as one would wish for

research problems. Nevertheless, as the value of the Department to the industry lies essentially in its advisory service, attention to advisory work was given the highest priority. This work is not without its advantages, as it provides an index of the problems confronting the industry in the different districts and a clue to the lines on which research could most profitably be undertaken.

7. Visit to Assam.—The Tea Section Committee having approved, the long-standing invitation of the Tea Pathologist of the Indian Tea Association to visit Tocklai was availed of. The visit was made in October when, besides Tocklai, a number of tea gardens in the neighbourhood of Tocklai and in Cachar District were visited. It provided an opportunity to see something of *Helopeltis* in N.-E. India and also of other aspects of tea cultivation in that area. A full report on the visit was submitted.

8. Blister Blight.—Work on this disease was continued during the year. A trial on the efficiency of copper and organic fungicides and another on the effect of height of tipping on the incidence of the disease were carried out during the year. An account of these trials is given in a separate section to follow.

A small number of plants, about 40, vegetatively propagated from a blister resistant bush, have recently been transferred to the field and their field performance is being closely watched.

9. Defoliation.—This problem received great attention during the year and the work done so far and the results obtained are referred to in detail in the reports of the Soil Chemist and Botanist. Mention may only be made here of a small trial made to observe the effect on the defoliating bushes of a heavy prune carried out in the dry weather. The majority of bushes failed to recover from pruning and died, but such of those as were watered throughout the dry season recovered normally. When soil moisture is a limiting factor, as appears to be the case in the dry weather, a heavy clean prune on weak tea seems highly inadvisable.

10. Vegetative Propagation.—It is realised—and this realisation was further strengthened after a visit to Ceylon and Assam—that South India is much behind in vegetative propagation work. Shortage of staff was the main reason for this Department not undertaking this work on any large scale in the past, and although the position in this respect has not eased even now, the importance of vegetative propagation, especially at the present moment, prompted an attempt being made to start this work with the time available to the existing staff. Having regard to the all too frequent failures which estates appear to have suffered in their attempts, it was considered essential, as a first step, that a standard technique suited to S. Indian conditions should be worked out. Trials have been started with different shade and soil types.

11. Plant Protection Formulations and Equipment.—Samples of new plant protection formulations have continued to be received for trial, but opportunities available during the year did not permit of testing more than a few of them. On such of them as were tested, reports were made and sent to the suppliers.

The only new equipment tried was a midget knapsack power duster, a reference to which is made in a later section under " HELOPELTIS ".

ENTOMOLOGICAL

12. Entomological enquiries received during the year were comparatively few. Except for a few instances of local damage by some of the minor pests on individual estates, tea was on the whole free from outbreak of any serious pest during the year. The same may be said of shade trees also.

13. Helopeltis.—No further investigation was undertaken on this pest during the year, but a visit was made to Central Travancore in September/October 1949, in order to get an idea of the extent to which dusting was being adopted on Estates, of any practical difficulties experienced in carrying out large programmes and of the results obtained. The consensus of opinion was that the results were eminently satisfactory and in many cases they appear to have far exceeded expectations. There was thus a general satisfaction over the efficacy of treatment in the control of the pest.

Dusting so far is mostly done with hand machines; power machines have not yet become popular, mainly because the former are simpler to handle and are found to give very good results and partly because of the high initial cost of power machines and the trained personnel required for satisfactory operation. A midget knapsack power duster was the subject of a small trial during the year and although it is capable of being worked by a single operative, it proved too cumbersome in its present form to be carried amidst tea bushes and unsuitable for handling by unskilled labour. Moreover, its range was very limited and did not far exceed that of a good hand-operated rotary duster.

On the question of separation of DDT and China clay from the mixed formulation, further studies have not been possible with the power machines but a few tests were made with a hand duster of the rotary type. The data collected so far have been so conflicting that they have only served to emphasise the complexity of the problem and to point to the need for considerable further work in order to be able to arrive at a satisfactory solution to the problem of separation.

An alternative ' filler ' for china-clay was investigated during the year. Steatite, a soapstone available in a very finely divided powder form, appeared to satisfy all the requirements, except one, of an insecticide diluent. Its reaction was alkaline, the pH value being 8.15. Should it be found that this is not a serious objection to its use with DDT—it does not appear to be as far as our tests go—steatite promises to be a useful substitute for china-clay.

Several enquiries concerning dusting were received during the year and these mostly sought details of method of formulation, sources of supply, etc., and some wanted a check up on the DDT content of formulations which they had compounded locally. There was generally a close agreement between the percentage aimed at and the actual percentage secured, so that, if the mixing is done as advised, there is no room to doubt that a satisfactory ' mix ' may not be obtained. Mention may be made of one enquiry, however, which expressed doubt about the efficiency of DDT—china-clay mixture stored for some months. The doubt was unfounded as the chemical analysis of the sample revealed no deterioration of the DDT in the sample. It must be remembered that a cursory test will not bring about immediate death of the insect, and that it takes any time upto 6 hours for the toxic symptoms to become manifest.

The visit to Assam undertaken in October 1949 provided an opportunity to study the condition of the pest in Cachar, one of the districts subject to *Helopeltis* attack. A detailed report on the visit was made, but the impression was inescapable that, according to S. Indian standards, attacks there were comparatively light. In Central and South Travancore the attack in October is generally far more severe than was seen anywhere in Cachar.

The possible risk of increase of Red Spider as a result of DDT dusting has been kept in view and the position is being carefully watched. No such increase has so far been observed or reported from estates which have carried out extensive programmes of DDT dusting during the past 2 years.

14. Thrips.—Opportunity was available during the year to carry out a few trials in the control of thrips on an estate in the Nilgiris. Two dust formulations were used, one a proprietary product having a pyrethrum base and the other DDT, and both gave satisfactory results. In view of the fact that DDT dust was the cheaper of the two, especially when mixing was done locally, and considering also the successful results obtained with it in *Helopeltis* control, it was selected for large-scale application. Results from such application appear promising, but modifications in technique, percentage of DDT in the dust formulation necessary to give efficient control, the timing of applications, etc., have yet to be worked out before being able to place thrips control on a satisfactory basis.

15. Mites.—The exceptionally severe drought conditions experienced during the year in most tea districts gave rise to mite attacks of more than usual prevalence. Several reports were received from estates of different districts and the predominant species was Purple Mite, *Eriophyes carinatus*. It is usually expected that mites would disappear after the rains start and good growing conditions prevail, but this may not always happen. In cases where mites persist even after the monsoon starts, dusting or spraying with sulphur may have to be considered. Reports so far received, however, do not warrant a general recommendation being made in respect of sulphur application. The coming year will probably provide the necessary information as to the necessity or otherwise for an appropriate control measure against mite attacks.

16. Eelworm.—This pest continues to be a problem in tea nurseries as evidenced by a large number of reports received during the year. The trouble has largely been overcome in the case of basket nurseries by heat application to the soil used for filling in the baskets. In bed nurseries, use of soil fumigant would probably be helpful, but unfortunately a trial started with Dowfume, a proprietary soil fumigant claimed to possess high nematocidal value, proved inconclusive as the worm infestation in the nursery beds did not develop sufficiently to be able to assess the value of the soil fumigant. A further trial is now in progress in which both Dowfume and another soil fumigant, 'Shell D.D.', are being tested together.

17. Scale Insects.—Attacks by scale insects were reported from estates in the Nilgiris, Nilgiri-Wynaad and Anamallais. *Saissetia coffeae* (Brown Bug) and *Ceroplastes* sp. were the species involved. Scale insect attacks are probably to be looked upon as indicative of the generally weakened condition of tea.

18. Red Slug.—This pest was reported from an estate in Central Travancore where it appeared to have defoliated some 20 bushes. It is usually of sporadic occurrence and appears both alone and, more frequently, in association with nettlegrubs. These pests have ceased to be of any importance since their last epidemic in 1935–36, but considering the severe damage they are capable of inflicting, it is advisable to keep a constant watch on them as there is no knowing when they would appear in damaging numbers.

Besides collecting and burning all fallen leaves from underneath the infested bushes in order to destroy the cocoons, spraying with soap solution was being recommended in the past for dealing with small outbreaks of the pest. DDT may perhaps be used now with better results, the concentration recommended being 1 lb. of 50% DDT wettable powder in 20 gallons of water.

19. Psychids.—Enquiries relating to damage by two species, *Clania crameri* (Faggot-worm) and *Psyche* sp. (bag-worm) were received from Malabar and South Travancore respectively. The former was reported to have caused considerable damage over one acre of new clearing. Short of picking and burning the ' faggots ', there is at present no other remedy. The use of DDT and other new insecticides in the control of this pest has not yet been tried, but should the situation warrant, trials will be made when next there is an opportunity.

Bag-worm (*Psyche* sp.) is also a pest against which chemical control has not proved successful in the past. In the case under report, the pest appeared to have originated from *Albizzia* and spread to tea. In such a case, lopping of the infested branches of the shade tree and burning the loppings should help to control the pest.

Of the other pests reported during the year mention may be made of the following:—Tea Aphis in nurseries, grasshoppers in a new clearing of tea, and *Indarbella* sp. (a bark-eating borer) in *Albizzia*. The last pest was understood to have been dealt with successfully by injecting DDT wettable compound into the borer holes with a syringe.

20. Acknowledgements.—Grateful acknowledgements are made to Messrs. A. V. Thomas & Co., Ltd., for housing facilities provided on Arnakal Estate during the visit made to Central Travancore and to Managers of estates visited during the year for assistance and hospitality received.

My thanks are also due to the Officers of the Tocklai Experiment Station and the Research Institute of Ceylon for assistance and courtesies received during visits to their Institutes. I must specially record my appreciation of the assistance of Mr. Hainsworth, the Pathologist and Dr. Das, the Entomologist, both of Tocklai, who spared no pains to make my visit to Assam as enjoyable and instructive as possible.

Messrs. Tea Estates (India) Ltd. offered cooperation and provided facilities for carrying out control work on Thrips on Terrace Estate. I have to thank them and, in particular, Mr. G. R. Thurnham for his keen interest and cooperation in the work.

S. ANANDA RAU,

Asst. Tea Scientific Officer & Entomologist.

BLISTER BLIGHT

The work carried out on Blister Blight is outlined in this separate section both for the sake of convenience and by reason of the fact that all the members of the staff have cooperated in the conduct of the trials undertaken during the year. A brief account of these trials is given below.

1. Spraying Trials.—In a bed nursery on a neighbouring estate a spraying trial to test the effect of organic and inorganic fungicides in the control of Blister Blight was started in June 1949. The lay-out of the experiment was of a randomised block design, each treatment being replicated six times. 5 fungicides (the first 6 listed below) were tested and two further fungicides, which were received too late to be included in the original lay-out, were tested in a separate block from September onwards.

Fungicides	*Rate of application*
1. Malachite green	10 parts per million
2. Perenox	2 ozs. in 10 gallons
3. Wetcol (1)	2 ozs. in 10 gallons
4. Wetcol (2)	1 lb. in 15 ,,
5. Product '1001'	1 lb. in 30 ,,
6. Dithane	2 qts. in 100 ,,
7. Fermate	1½ lbs. in 100 ,,
8. Copper Sandoz	2 ozs. in 10 ,,

The seedlings were sprayed every week from 25th June 1949 to 6th December 1949, except during 4 weeks when the disease was practically absent in the nursery. For purposes of observation and recording, 300 seedlings in each bed were marked off. The number of infected plants and the number of infected leaves in each plant were recorded every week. Only leaves showing mature blisters were taken as infected. A summary of the results obtained is given in the following table.

TABLE 1

Average % plants affected

	Whole period of trial	*1st phase of heavy infection*	*2nd phase of heavy infection*
Control	7.3	14.3	10.0
Malachite green	7.7	15.3	10.9
Dithane	4.3	10.3	5.1
Wetcol (1)	3.7	6.7	5.3
Wetcol (2)	2.0	1.7	2.4
Product '1001'	2.3	5.7	1.1
Perenox	1.7	2.0	1.7
Control			8.0
Fermate			6.3
Copper Sandoz			1.5

The first phase of heavy infection lasted from 30-7-1949 to 27-8-1949 and the second phase from 22-10-1949 to 26-11-1949.

TABLE 2

Efficiency of the Fungicides

(% *reduction in intensity over no treatment*)

	Whole period	1*st phase*	2*nd phase*
Malachite green	Nil	Nil	Nil
Dithane	41.1	28.0	49.0
Wetcol (1)	49.3	53.1	47.0
Wetcol (2)	72.6	88.1	76.0
Product '1001'	68.5	60.1	89.0
Perenox	76.7	86.1	83.0
Fermate	...	...	21.3
Copper Sandoz	...	...	81.3

TABLE 3

% *Efficiency* (*Perenox*=100)

Malachite green	Nil	Nil	Nil
Dithane	53.6	32.5	59.0
Wetcol (1)	64.3	61.8	56.6
Wetcol (2)	94.6	102.4	91.6
Product '1001'	89.3	70.0	107.2
Fermate	...	...	25.6
Copper Sandoz	...	...	97.9

The conclusions from the above trials are :—

(1) Malachite green was ineffective in controlling the disease.

(2) The other organic fungicides, Dithane and Fermate, were not as efficient as copper fungicides.

(3) Perenox, Product '1001' (a proprietary product containing 30% DDT and presumably copper sulphate), Wetcol (2) and Copper Sandoz were all of about the same order of effectiveness.

(4) Wetcol at 2 ozs. in 10 gallons of water was less efficient than Perenox at the same dilution, due presumably to its lower content of copper.

(5) No fungicide completely controlled the disease even after repeated weekly applications over a period of six months. Even in the case of Perenox the mean efficiency over the whole period was only 76%. This is more likely to be due to the method of application (spraying was mainly done to wet the under surface of the leaves and not both the surfaces) rather than to any lack of efficiency on the part of the fungicide.

2. **Tipping Experiment.**—As mentioned in last year's report, shoots from each of the 16 plots of this experiment were examined for intensity of infection in all plucking rounds. For this purpose 100 shoots were chosen at random from the pluckings from each plot and scores given for each shoot as follows :—0 for no infection, 1 for oily spots only, 2 for mature blisters less than 5 on a leaf and 3 for mature blisters more than 5 on a leaf. Observations began from 15th July 1949 and continued till 16th January 1950. Examination of the figures showed that the difference in intensity of infection between

the two heights of tipping was negligible. By way of illustration, the figures for some weeks during which the attack was severe are given below :—

TABLE 4

	3″ Tip SCORE				6″ Tip SCORE			
	0	1	2	3	0	1	2	3
2–8–1949 ...	18.0	31.5	42.8	6.1	16.6	38.8	40.0	5.1
11–8–1949 ...	11.5	38.5	43.0	8.5	10.8	45.1	37.1	8.0
19–8–1949 ...	8.9	32.3	44.1	17.5	7.0	36.0	44.0	19.2
10–9–1949 ...	29.0	27.8	38.8	4.6	30.6	28.8	36.6	2.3

The difference in crop was in favour of 3″ tipping which gave about 13% more green leaf than 6″ tipping, but this difference was not statistically significant.

3. Dusting Trial.—A replicated trial, employing specially formulated fungicide dusts containing 10%, 7½% and 5% copper, was started towards the end of the year in order to determine the questions of taint and copper contents of made tea as a result of dusting and the fungicidal value of the dust formulations. Three rates of applications, *viz.*, 15 lbs., 25 lbs., and 35 lbs., per acre, are being tested for each strength of dust and dusting is being done at weekly intervals. The results will be reported fully after the trial is completed.

REPORT OF THE SOIL CHEMIST
(1949–1950)

1. Advisory.—The following samples were analysed and reported on during the year in connection with advisory work.

Soils	98
Composts	2
Farm yard manure, Tea fluff, Tea dust, Coffee pulp and Castor seed for oil	1 each
DDT mixtures	2
Manures and manure mixtures	22

The heads of analysis of the soil samples examined depended on the nature of enquiry received. The majority were analysed for organic matter, nitrogen and reaction while some were analysed for physical texture and others for nitrogen, phosphoric acid and potash. The samples also included those from healthy and ' defoliated ' areas of tea and comments on their analyses are given under the head ' defoliation '.

All the manure and manure mixture samples conformed to the guaranteed analysis.

Besides the above, twenty-eight enquiries involving no analysis but asking for advice relating to manuring of tea, preservation of cattle manure, use of waste materials from tea factories and cultivation of Coffee, Cocoa and Citrus were attended to.

The better appearance in the middle of dry weather of tea growing adjacent to a row of Grevilleas, in contrast to the rest of the tea in the area, prompted an investigation into the cause of this difference. Soil samples from two rows of tea growing directly under and away from Grevillea shade were analysed for moisture and organic matter. While there was no appreciable difference in the organic matter content between the two sets, the top and sub-soil samples under shade showed 4% and 1.2% more moisture respectively than those away from shade. The higher moisture content as a result of the thick mulch of Grevillea leaves was considered to be the main factor responsible for the better growth of tea adjoining Grevilleas.

2. Touring.—Visits were made to two estates in Nilgiri-Wynaad to advise on the general improvement and manuring of tea and to study the cause of healthy and poor growth of tea and Grevilleas in certain patches of the estates. An estate in the Nilgiris was visited in connection with an experiment laid down there. Weekly visits were paid to a neighbouring estate in connection with spraying trials against Blister Blight in a bed nursery. A stay of three days was made in Coimbatore for reference work on DDT analysis in the library of the Agricultural Research Institute. The Scientific Conference held at Coonoor was attended and specimens of soil from the different tea districts were exhibited.

3. Defoliation.—In connection with the investigation of this problem, a series of analyses of soil and wood tissues were undertaken during the year. These consisted of soil and wood samples from healthy and defoliating areas on estates and from the 27-plot manurial experiment area on the Station. The object of these analyses was twofold, *viz.*, (1) to find whether defoliation

could be attributed to any deficiency of major plant foods in the soil and (2) to find the extent of uptake of nitrogen, phosphoric acid and potash supplied as manures by the healthy and defoliating bushes.

Several soil samples collected by the writer from the healthy and poor areas on estates during visits and samples sent by Managers were examined for loss on ignition, nitrogen, phosphoric acid and potash (total and available) and reaction. The soil samples which were taken from the 27 plot area on the Station during 1947–48 for the determination of nitrogen and loss on ignition were used for analysis of phosphoric acid and potash (total and available). Wood samples were obtained by the procedure described below :—In each of the 27 plots of the manurial experiment area on the Station 6 healthy bushes and 6 bushes showing partial defoliation were chosen at random and marked. From each of these bushes a piece of wood 4″ long and about 1/3rd inch thick was cut at 2″ above the previous pruning level. The samples from the two groups of six bushes from each plot were cut into thin slices, dried, ground in a coffee mill and a representative portion taken for analysis. Thus there were 27 samples from healthy and an equal number from defoliating bushes. The results of the analysis are summarised below :—

Soil Analysis : (Estates).

	Loss on Ignition	Nitrogen	Phosphoric acid Total	Phosphoric acid Available	Potash Total	Potash Available	pH
	%	%	%	%	%	%	
ESTATE 1							
Sample 1							
Healthy ...	11.9	0.179	0.053	0.0049	0.298	0.008	5.34
Defoliating ...	14.2	0.204	0.042	0.0023	0.221	0.012	5.19
Sample 2							
Healthy ...	10.6	0.159	0.101	0.0053	0.310	0.007	5.22
Defoliating ...	10.7	0.160	0.059	0.0031	0.400	0.009	5.12
ESTATE 2							
Sample 1							
Healthy ...	11.7	0.186	0.097	0.0054	0.180	0.010	5.32
Defoliating (*a*) ...	13.8	0.240	0.076	0.0047	0.190	0.016	5.15
,, (*b*) ...	11.2	0.268	0.093	0.0068	0.428	0.016	4.54
Sample 2							
Healthy ...	14.5	0.220	0.034	0.0052	0.186	0.008	5.80
Defoliating ...	13.5	0.247	0.087	0.0062	0.214	0.012	5.80
Sample 3							
Healthy ...	11.3	0.187	0.064	0.0053	0.280	0.008	5.12
Defoliating ...	11.1	0.192	0.076	0.0040	0.215	0.019	5.46

Soil Analysis : (Station Manurial Area).

The figures for loss on ignition and nitrogen were given in the Annual Report for 1947–48. The phosphoric acid and potash contents of these soils are tabulated below. The plots of this experiment have received for the past 9 years no manure, and 20 and 40 lbs. each of phosphoric acid and potash in the form of superphosphate and muriate of potash. There are nine plots for each treatment and the average of 9 plots is given.

	No. P	20 lbs. P	40 lbs. P	No. K	20 lbs. K	40 lbs. K
Total % ...	0.049	0.060	0.066	0.149	0.169	0.177
Available % ...	0.0022	0.0026	0.0024	0.011	0.0107	0.012

Differences are not significant.

It may be seen from the above figures of analysis of Estate samples that healthy and defoliating areas reveal no differences to which importance can be attached. The soils are typically representative of the district (Nilgiri-Wynaad), fair in organic matter and nitrogen, medium in potash and poor in phosphoric acid. It would appear that ' defoliation ' cannot be attributed to any deficiency of major plant foods in the soil.

From the figures for Station manurial plots there is an indication of increase in the phosphoric acid and potash contents of the soils manured with these plant foods, though the differences are not statistically significant. But the yield of tea and the extent of ' defoliation' are found to differ significantly in the potash treated plots.

In the following table are given the nitrogen, phosphoric acid and potash contents of the wood samples. Only 18 out of the 27 sets have been analysed and the averages are given for each treatment.

	Nitrogen in wood			Phosphoric acid in ash of wood			Potash in ash of wood	
	Healthy	Defoliating		Healthy	Defoliating		Healthy	Defoliating
	%	%		%	%		%	%
0 lbs.	0.7259	0.5587	0 lbs.	9.15	7.32	0 lbs.	19.64	16.40
40 lbs.	0.6569	0.5840	20 lbs.	11.35	9.40	20 lbs	22.78	17.23
80 lbs.	0.8284	0.6032	40 lbs.	13.20	10.02	40 lbs.	28.80	20.88

These figures indicate that (1) the plant food contents are always less in the samples from defoliating bushes whatever the treatment given, and (2) both the healthy and defoliating bushes generally show progressively higher plant food contents in the manured plots than in the control.

The second feature suggests that although defoliating bushes have made use of added fertilisers, their uptake is much lower than that of healthy bushes and probably falls below the level at which satisfactory growth is possible. The figures will be commented on in greater detail when all the sets have been analysed and the figures statistically examined.

It may be interesting to record that a similar trend of figures was obtained from wood samples collected from healthy and defoliating bushes on the Station (non-experimental area) and on an estate in Nilgiri-Wynaad.

	Station		Estate	
	Healthy	Defoliating	Healthy	Defoliating
	%	%	%	%
Ash ...	2.36	1.32	2.20	1.80
Nitrogen ...	0.801	0.597	0.953	0.718
Phos. acid ...	9.51	8.07	8.29	6.05
Potash ...	20.88	15.50	19.27	12.03

4. Blister Blight.—Considerable time was spent in connection with experiments on the control of this disease. The details regarding these experiments are given in a separate section.

5. DDT & 'FILLER' SAMPLES.—Relative density, hygroscopicity and bulking values of a number of proprietary brands of DDT and ' filler ' samples were determined during the year.

In order to find whether 50% DDT samples deteriorate on exposure to sun, three brands were exposed outside the laboratory for two months—May and June. There was very little difference between the original and final figures, suggesting thereby that no deterioration took place.

To test whether the alkaline reaction of a filler (pH-8.15) has any adverse effect on pure technical DDT when mixed with it and preserved for some time, a mixture of the two to give 50% DDT was kept exposed inside the laboratory in a dish for two and a half months. It was found that during this period the reaction of the filler had no effect on the final DDT content of the mixture.

One lb. of locally mixed 3% DDT dust was put through a duster and the settling dust was collected at every foot to a distance of 18 feet and analysed. In 17 samples out of the 18 the DDT content of the settled dust was lower than that of the original sample (3%). This feature is the reverse of what was reported in last year's report and is difficult to explain satisfactorily.

6. FIELD EXPERIMENTS.—The yield data for the field experiments are given below :—

PLANT FOOD REQUIREMENTS

(A) 27 plot (3×3×3) Factorial Experiments.

(1) Tea Experimental Station.—The yield figures for the third year of the third cycle are summarised in Table 1.

TABLE 1

Nitrogen	... 0 lbs.	40 lbs.	80 lbs.	
Yield	... 909.0	1006.5	1351.2 lbs.	made tea/acre
Phos. acid	... 0 lbs.	20 lbs.	40 lbs.	
Yield	... 1057.8	1147.9	1161.0	,, ,,
Potash	... 0 lbs.	20 lbs.	40 lbs.	
Yield	... 759.0	1133.7	1374.0	,, ,,

Difference required for significance :

P=0.05 : 292.1 lbs.

P=0.01 : 442.5 lbs.

Nitrogen at 40 lbs. again failed to increase the yeild significantly. The higher dose, 80 lbs. continued to give significant increase. The yields during this year were considerably less than those of the corresponding years of the previous two cycles. The tea was pruned during the second fortnight of November 1949.

The potash effect, mentioned in last year's report, became more marked during the year. It may be remembered that it was only the higher dose

of potash, *i.e.*, 40 lbs., that gave increased yields significant at 5% level last year. This year, not only is the higher dose significant at 1% level, but the lower dose also gave significant increase, though only at 5% level.

(2) **Anamallais (Mudis).**—Following are the yield data for the second year of the pruning cycle :—

TABLE 2

Nitrogen	...	0 lbs.	30 lbs.	60 lbs.	
Yield	...	864	867	884 lbs.	made tea/acre.
Phos. acid	...	0 lbs.	20 lbs.	40 lbs.	
Yield	...	861	876	876 ,,	,, ,,
Potash	...	0 lbs.	20 lbs.	40 lbs.	
Yield	...	860	874	860 ,,	,, ,,

Differences are very small.

(B) 48 plot (6×8 Randomised block) Experiment.

(1) **Anamallais (Mudis).**—The third year yield data are as follows :—

TABLE 3

Nitrogen	...	0 lbs.	40 lbs.	
Yield	...	867	871 lbs.	made tea/acre.
Phos. acid	...	0 lbs.	20 lbs.	
Yield	...	866	871 ,,	,, ,, ,,
Potash	...	0 lbs.	20 lbs.	
Yield	...	878	860 ,,	,, ,, ,,

Differences between treatments are extremely small.

(C) 24 plot (3×8 Randomised block) Experiment.

Nilgiris (Korakundah).—There was no plucking in this area for three months during the year due to frost and dry weather. The figures are given in Table 4.

TABLE 4

Nitrogen	...	0 lbs.	40 lbs.	80 lbs.	
Yield	...	656	711	646 lbs.	made tea/acre.

Differences between treatments are not significant.

(D) 24 plot (4×6 Randomised block) Experiment.

Nilgiris (Korakundah).—As in the case of the first experiment, owing to frost and dry weather there was no plucking for three months.

TABLE 5

		No Manure	Nitrogen 50 lbs.	Lime 10 cwts.	Nitrogen+Lime
Yield	...	479	501	458	511 lbs. made tea/acre.

No significant difference between the treatments.

(E) 25 plot (5×5 Randomised block) Experiments.

High Range (Kanniamallay, Munaar, Letchmi and Nullatanni).—The experimental area on Kanniamallay was pruned during December 1949 and hence the yield data are given for a period of 8 months only. There was no plucking in the area in Nullatanni during January, February and March owing to frost and dry weather. The yield figures are tabulated below:—

TABLE 6

	No Manure	Nitrogen	Nitrogen + Phos. acid	Nitrogen + Potash	Nitrogen + Phos. acid + Potash
Kanniamallay ...	702.6	792.2	750.1	754.9	783.0
Munaar ...	661.0	703.6	737.6	733.9	729.6
Letchmi ...	524.9	507.6	541.6	537.8	502.2
Nullatanni ...	380.2	527.6	549.2	489.2	533.5

By a straight analysis of variance the differences between treatments are significant only in Kanniamallay [(P=0.05)=58.4 lbs.]. Analysis of the yield data by the method of co-variance shows that the treatments are also significant in Munaar and Nullatanni. It is only in Letchmi that there is no response to fertilisers and this may be attributed to the extreme heteriogeneity of the plots.

(F) COMPOSTS AND GREEN MANURES

Anamallais (Iyerpadi).—There was no response to the different treatments for the last 6 years and hence it was decided to discontinue this experiment.

(G) CULTIVATION

24 plot (3×8 Randomised block) Experiment.

Nilgiris (Korakundah).—Following are the yield data for 9 months of the year :—

TABLE 7

	Control	Forking	Trenching
Yield ...	425	397	482 lbs. made tea/acre.

Treatments are not significant.

(H) TIPPING HEIGHT

Tea Experimental Station.—The yield figures of this experiment mentioned in the Mycological section of the last year's report are :—

TABLE 8

3″ Tipping ...	2,111 lbs. green leaf.
6″ Tipping ...	1,860 lbs. green leaf.

The difference is not significant.

Acknowledgements.—Grateful thanks are due to Managers and Staff of estates visited for help and courtesies received.

V. JAYARAMAN,
Soil Chemist.

REPORT OF THE BOTANIST

(1949–1950)

Advisory.—Correspondence during the year numbered 136 letters despatched, majority of which being replies to technical enquiries from estates. A greater part of the enquiries concerned diseases of tea, while the others pertained to coffee, rubber and other plants.

Touring.—Attended the U.P.A.S.I. Scientific Conference and Exhibition held at Coonoor during the month of August 1949. An estate on the Nilgiris was visited in October 1949 for the collection of a red-leaved *Camellia*, presumably different from the commercially grown species. Forty-five visits were made to the estates in the neighbourhood of the Station in connection with the experiments started there.

Publications.—The following were published in the *Planters' Chronicle*.

i. Note on ' Systemic Fungicide ', Vol. 44 (1949), p. 177.

ii. A note on a Leaf Disease of Rubber in South India, Vol. 44 (1949), p. 581.

iii. The Inhibition of the Growth of Fungi by Certain Dyestuffs.

I. Some observations on the effect of Malachite Green on the growth of *Rhizoctonia solani* and on the germination of the spores of *Pestalozzia theae*, Vol. 45 (1950), pp. 5–10.

iv. An Instance of Polyembryony in Tea, Vol. 45 (1950), pp. 180–81.

TEA [*Camellia sinensis* (L.) O. Kuntz]

Mycological :

1. *Leaf diseases.*—Blister Blight (*Exobasidium vexans*) continued to be the major leaf disease during the year. Occasional reports of Black Rot (*Corticium invisum*), Cercosporella disease (*Candelospora theae*), Grey and Brown Blights (*Pestalozzia theae* and *Glomerella cingulata*) were received. Sporadic attacks of *Phoma theicola* were also reported from a few estates, especially during the dry weather. Species of *Helminthosporium*, causing a leaf disease resembling the Brown Blight to an extent, was noticed for the first time on the Station. This, however, was confined to a few bushes and did not appear to spread.

Blister blight experiments.—Co-operated in these experiments, an account of which appears elsewhere.

2. *Stem and root diseases.*—Occasional specimens of Pink Disease (*Corticium salmonicolor*, Black Root Rot (*Rosellinia arcuta*), Charcoal Stump Rot (*Ustulina zonata*) and *Poria* sp. were received for examination.

There has been a marked increase in the number of bushes diagnosed as having been killed by the Brown Root disease (*Fomes noxius*) during the year. This disease is always associated with the presence of stumps of felled shade or jungle trees and infection can almost invariably be traced to a root of a stump remaining in the field. When shade trees are felled in large numbers, the risk of this disease may be great. Grevilleas are susceptible to this disease and it is also known that this disease spreads rather rapidly. It may,

therefore, be desirable to uproot stumps of felled trees or otherwise kill the trees marked for felling by any chemical tree killer or by ringing, thus eliminating the infection foci.

A stem blight, hitherto unrecorded in S. India, was noticed on an estate in Travancore. This fungus was first observed on the branches of Hevea rubber and later found spreading to tea. In its effect it resembled the White Thread Blight or White Stem Blight known to occur on rubber and tea, and there was a general whitening of the affected branches. White to cream coloured cord-like structures were seen to branch off freely on the affected branches and the smaller twigs bore cords only, without any general whitening, resembling the ordinary Thread Blights. No anker cells, the usual feature associated with the parasitic Thread Blight of tea in N.-E. India, could be seen and the growth of the fungus was mostly superficial. Only the vegetative stage of the fungus was observed and even on culturing the fungus on artificial medium and on tea stem bits, the perfect stage of the fungus could not be obtained.

3. *Tea seed and seedlings.*—A number of seed samples, reported to show poor germination, was received from several estates. Some of the samples were found affected by various fungi (species of *Fusarium*, *Penicillium*, *Aspergillus* and *Mucor*), while others showed an imperfect development of the cotyledons, suggesting that the seeds were immature. Hard-shelled seeds were also encountered in some of the samples.

Wilting of seedlings was reported from a nursery and the diseased seedlings yielded a species of *Fusarium*.

4. *Laboratory studies:*

(*i*) *Blister Blight—Brown Blight association.*—Premature blackening of blisters was reported from a number of estates and the Brown Blight fungus was invariably found associated with all the specimens observed. This suggested that the latter fungus might play a part in the premature death of the blisters and certain preliminary experiments undertaken in the laboratory showed that the Brown Blight fungus, if it invaded the blister spot in its early stage of development, *viz.*, when the oily or translucent spot was not more than a mere speck, prevented the formation of the blister. On the other hand, if the blister was invaded when the spot had enlarged but before the fungal tissue broke through the epidermal layer of the leaf, spore production was checked to a considerable extent and it also resulted in the premature drying out of the blister. Infection when blisters were fully formed did not prevent spore production. It was also noticed that in all these the Brown Blight fungus spread farther than the area affected by the Blister Blight fungus, thus killing a greater part of the leaf. Such an effect was also observed on leaves in the field, where the Grey Blight fungus (*Pestalozzia theae*) was occasionally seen to invade the blisters.

(*ii*) *Effect of Malachite green on Blister Blight.*—Spraying trials having failed to show any beneficial effect of malachite green (10 p.p.m.) in the control of Blister Blight in the nursery and with a view to determine if the dye when absorbed into the shoot would inhibit the development of blisters, shoots showing translucent spots of Blister Blight were kept with their cut ends immersed in tap water and in solutions of malachite green containing 5 and 10 p.p.m. of the dye. The spots developed into mature blisters in all the cases in twelve days indicating that the dye at the concentrations tried had no effect on the fungus.

(*iii*) *Resistance to Blister Blight.*—A single bush on the Station showed remarkable resistance to the Blister Blight fungus. In spite of pruning the bush during the Blister Blight season so as to allow plenty of succulent tissue to be exposed to the fungus, Blisters were not seen on the bush, although all the surrounding bushes were badly affected. Artificial inoculation, both in the field and in the laboratory, failed, except that some small spots, which never developed into mature Blisters, were formed at the points of inoculation. A study on the mechanism of resistance was started and the preliminary indication was that the progress of the invading hypha was checked by mechanical resistance offered by the death of the host cells. In the susceptible tissue the mycelium was seen to spread through the intercellular spaces of the leaf mesophyll without any limitation. On the other hand, in the resistant tissue the host cells surrounding the infection locus of the fungus became necrotic, *i.e.*, the cells surrounding the invading hypha were discoloured and were apparently dead. Perhaps because of this feature the fungus encountered difficulty in developing further, being an obligate parasite thriving on living tissues of the tea leaf, or it is possible that the toxins from the dead cells, if any, might have inhibited the growth of the pathogen. These observations, however, are only tentative, and further work, under way, is expected to throw more light on the actual nature of the mechanism of resistance to Blister Blight in this resistant tea bush.

(*iv*) *Perfect stage of Candelospora* (*Cercosporella*) *theae.*—*Calonectria theae* Loos, the perfect stage of the fungus causing the Cercosporella disease, was observed on some of the diseased tea leaves received for examination from an estate. A few small reddish brown perithecium-like bodies were seen on the under surface, and when the leaves were kept in a moist chamber for about a fortnight, a large number of such bodies developed. Some of them were empty, while the remaining ones contained asci and ascospores.

Young, detached tea leaves nourished in 5% glucose solution, inoculated with the ascospores and kept in a moist chamber developed the typical Cercosporella disease. The conidial form of the fungus was seen developing profusely on the infected leaves.

(*v*) *'White Stem Blight'.*—The perfect stage of this fungus could not be obtained on culturing on artificial medium or on sterilized tea stem bits.

(*a*) *Humidity and growth of the fungus.*—To study the nature of the spread of the fungus, a few pieces of infective material were tied on to branches of a tea bush in the field. The fungus did not spread and it was presumed that growth was inhibited by the prevailing very dry weather. Spraying the infective material with water, once in the morning and again in the evening for a few days continuously, also resulted in failure of the development and spread of the fungus. However, when the infective material was kept in a moist chamber (100% humidity) the fungus developed profusely resulting in a thick mat of mycelium on the stem bit within a few days. Thus it would appear that the fungus requires continuous high humidity for active development.

(*b*) *Action of certain fungicides on the fungus.*—Infected stem bits were dipped in solutions of Perenox (2 and 4 oz. in 10 gallons of water), Wetcol (2 oz. in 10 gallons of water), Fermate (16 oz. in 10 gallons of water), Malachite green (100 p.p.m.) and Caustic soda (2 per cent) and were incubated at room temperature in a sterile moist chamber. Except in the case of caustic soda

treatment, the fungus was seen to thrive in all the others. This would, therefore, suggest that the fungus could be controlled at the time of pruning with the help of a caustic wash as is generally applied to remove moss and lichen from the branches and to aid quick bud break.

Physiological

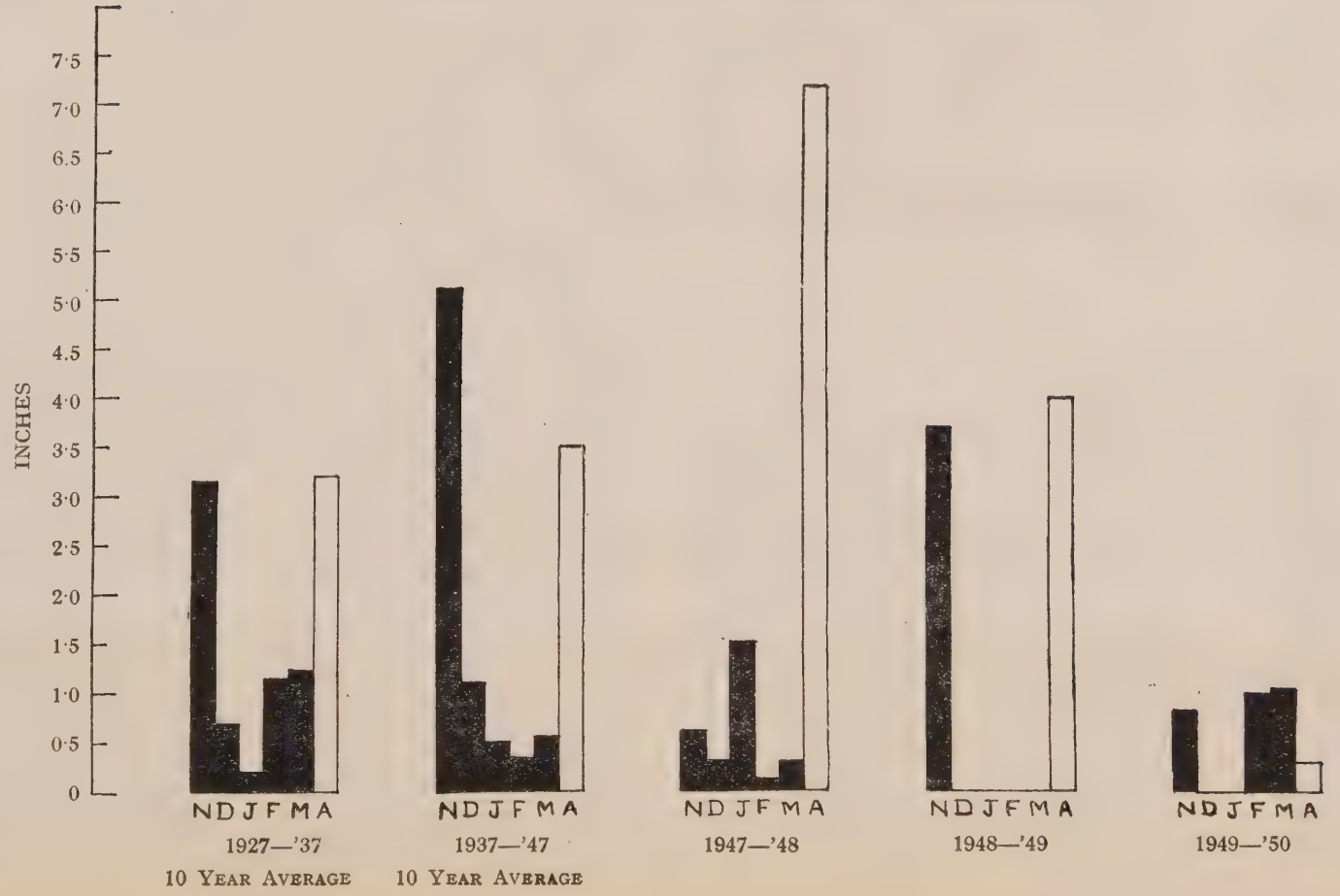
1. *Defoliation.*—This decline disease of tea continued to be reported from some estates in the Wynaad. As before, no particular micro-organism was associated with the debilitated plants. However, it may be of some interest to note in this connection that a number of bushes received at the Station for examination and that many of the dead bushes uprooted during the dry weather at the Station, showed *Botryodiplodia theobromae*, the presence of which in itself is an indication of lack of vitality of the bush and the susceptibility to which fungus is almost always associated with a shortage of carbohydrate reserves in the root. Tests for starch in the roots of the debilitated bushes invariably showed a deficiency or a total absence of this reserve food material. In view of the unfavourable environmental conditions particularly drought which had been severe in the affected areas for the past few years and the restricted manure application during the war and post-war period, it seemed likely that this decline was a physiological disorder brought on either by a limited water supply or a nutrient imbalance or an interaction of the two. These two aspects of soil moisture relationship and plant nutrition received consideration during the year and the observations made are summarized as follows :—

(*i*) *Nutritional aspect.*—As in the previous year, the existing manurial experiment on the Station provided further opportunities to study the course of the disorder in the variously treated N, P and K plots. The possibility of a minor element deficiency was also considered.

(*a*) *N, P and K relationship.*—As was done last year and already reported, a further census taken of bushes showing ' defoliation ' symptoms in all the 27 plots of the Factorial Experiment showed that the plots which received no application of potash throughout the period of the experiment had significantly more ' defoliation ' than those which had received an annual application of 20 and 40 lb. of potash per acre, the plots receiving the highest application being the healthiest. Similarly, counts of bushes which died during the dry weather in all these plots also showed that there were markedly more deaths in the potash untreated plots than in the treated ones. These indications are being followed up further.

An attempt was made to determine the nutrient status of the plant tissues of healthy and ' defoliating ' bushes following the Long Ashton rapid tissue test method using Morgan's reagent as the extracting medium. It was found difficult to extract potash directly from the fresh material, but extraction after ashing was successful. The test indicated a higher amount of potash in the leaves and stems of healthy plants than in those of the affected ones. This indication was followed up by complete chemical analysis by the Soil Chemist. Although the difference between the amounts of potash in comparable wood samples of healthy and affected plants was marked, the tests made so far showed that, in general, the wood of a ' defoliating ' plant was also poor in other plant foods, *i.e.*, nitrogen and phosphoric acid (see Report of the Soil Chemist.)

Fig. 1. RAINFALL FROM NOVEMBER TO APRIL.



In the manurial experiment at the Station an effect of potash on yield of crop was noticed, application of potash either at 20 or 40 lb. per acre per year significantly increasing the yield. Attention was, therefore, focussed on the possibility of potash deficiency being a factor in this disorder and experiments were carried out with the object of seeing whether additional potash supplied as fertiliser would have a beneficial effect on the ' defoliating ' bushes. There was no discernible effect consequent upon manuring within the one year of application. Injection of potassium in the form of potassium sulphate into the plants, both in liquid and solid forms, was tried but the results were not encouraging. The technique adopted for injecting, however, was not entirely satisfactory.

(*b*) *Minor elements*.—A field experiment was started on a neighbouring estate, in which soil application of zinc sulphate, borax and magnesium sulphate at the rates of 10 and 20 lb. per acre was tried on a debilitated tea field. Each treatment was replicated six times, each plot consisting of 144 bushes. Yield records were maintained from these plots and in each plot four bushes were marked out to determine the effect, if any, on the general growth and foliage density. The yield figures for the first ten months of the experiment did not show any significant difference over the controls. The bushes marked for periodical observations also did not show any visible improvement in their condition and, in fact, a large number of bushes was badly affected by drought in all the plots, irrespective of the treatment they had received.

(*ii*) *Soil moisture aspect*.—Precipitation during the period November to April has been markedly low for the years 1947–1948,1948–1949 and for the current year as compared with the averages for 1927–1937 and 1937–1947 (Fig. 1). In 1948–1949 a severe drought of 123 continuous rainless days was experienced, while the current year fared no better, although there was an inch of rain distributed over five days in February and another inch on a day in March. According to the findings of Dr. E. C. J. Mohr of Java, a month with a rainfall of less than 2.4 inches is to be considered a dry month; in other words, evaporation is greater than precipitation during that month. This finding can be applied generally to wet tropical regions and on this standard the Station and adjacent tea areas have experienced a continuous dry period of five months in 1947–1948, four in 1948–1949 and again five in 1949–1950. Normally the drought is broken in April, but this year April, too, was practically without any rain (Fig. 1).

These observations suggested that the continued droughts experienced in recent years may be a predisposing factor for the decline of the tea bushes in the drought affected areas and it was thought desirable to ascertain the soil moisture status during the dry period. Accordingly soil moisture determinations were made at fortnightly intervals from two adjacent tea areas, (i) unshaded and (ii) shaded. Soil samples were taken from six places in each of these two areas and at two depths, *viz*., 9 and 18 inches. The moisture level was determined on dry weight basis by drying the soil in a steam oven (Fig. 2.)

The shaded area showed markedly more moisture than the unshaded one at both the levels. Even at the height of the dry weather the soil moisture at the 18″ depth was about 19% in the shaded area, although the moisture level in the first 9″ of soil in the same area had fallen as low as 14.5%. On the other hand, in the unshaded area, the soil moisture at 9″ depth had fallen below the wilting coefficient of 13.7 (determined by the direct method of allowing potted seedlings to wilt permanently), while that at 18″ was just a little over the critical level.

The depletion of soil moisture to almost or below the wilting percentage can affect the plant in two ways, *viz.*, (*i*) by not providing sufficient moisture for root growth and the normal functioning of the plant parts, and (*ii*) by increasing the soil solution concentration. Although the soil solution may not represent the true culture medium of the plant, especially in respect of such nutrients as phosphorus and potassium which are released slowly by soils, as regards concentration of salts and their effect on plant growth it does represent conditions to which plant roots are subjected. The attainment of an osmotic concentration greater than that which can be tolerated by plants may be detrimental to crop production, and for a constant amount of salts the concentration found in the soil solution at the wilting percentage is the maximum to which a plant will be subjected.

While dealing with soil moisture it might also be of interest to add a few remarks regarding soil temperature. During the dry weather of the year under review, the afternoon soil temperature at 1 ft. depth in an uncultivated and unshaded area adjacent to a tea field generally averaged more than that during the corresponding period in 1948–1949. It was 93° F. in March 1950 with 12 days showing 95° F. and more. The soil temperature showed a further increase and it averaged 98° F. in April 1950, it being 100° F. and above for 10 continuous days during that month. The exact effect of such high soil temperatures on tea root growth is not known, but it is possible that the bulk of the feeding roots of the tea bush, which are in the first 18″ of the soil [Eden, T. (1940), *Emp. J. exp. Agric.*, 8, pp. 269–79, Manning, J. D. (1941), *Ann. Rpt.*, 1940–1941, *Tea Sci. Sect., U.P.A.S.I.*] may be adversely affected by such high temperatures. Root elongation of most plants almost or entirely ceases in very cold and dry soils and few or no unsuberized feeding roots generally exist at such times. According to Nightingale [*Bot. Gaz.* 96, (1935), pp. 581–639], potted apple and peach trees grown at soil temperatures of 45° F. and 95° F. produced no new roots and some of the old roots even died at the higher temperature.

The role of potash—in the deficiency of which nutrient plants are known to suffer in reduced vigour and general impairment of growth processes, and the presence of an adequate supply of which in the soil is also said to help the plant to utilize soil moisture more advantageously, especially during droughts—needs to be investigated further. The soil moisture and soil temperature relationships with the plant growth may also aid in the solution of this problem. These studies are, therefore, being continued.

2. *Vegetative propagation.*—No large-scale trials were undertaken. A few pilot experiments indicated no marked beneficial effect of any of the hormones used in these trials.

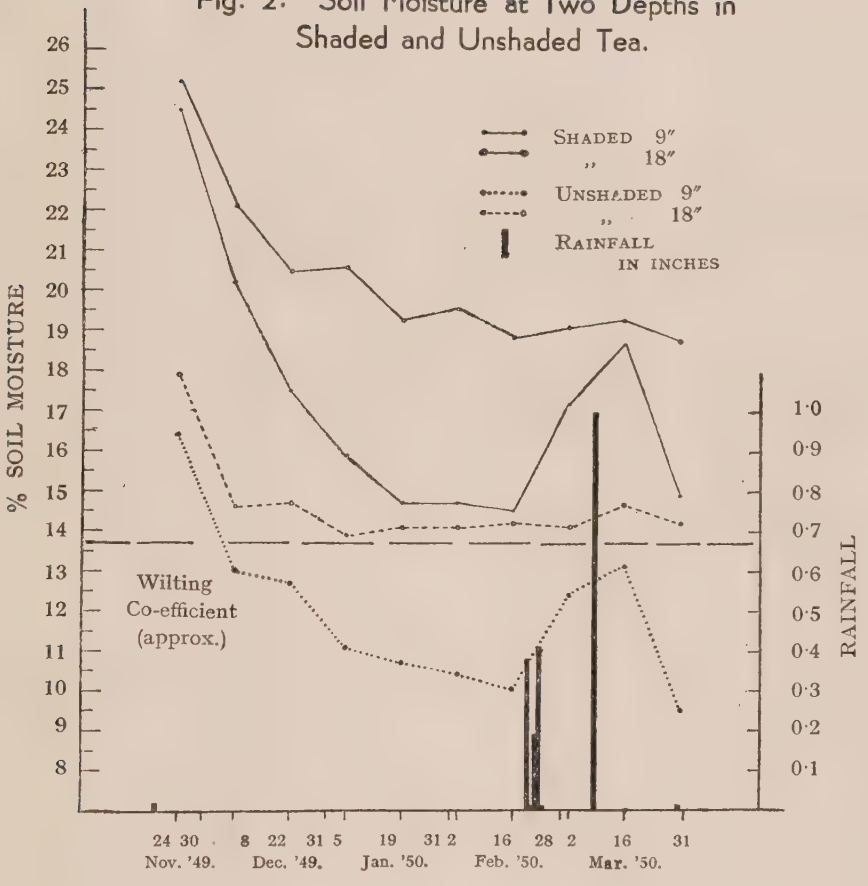
Polyembryony.—A few instances of polyembryony were observed. Chromosome counts in the root-tips of the polyembryonic seedlings showed the somatic number (2N) to be 30, which is the same as that of the normal tea plant.

Miscellaneous

(*i*) *Grevillea robusta.*—A root specimen of Grevillea received for examination was found affected by a species of *Fomes*.

(*ii*) *Cedrela serrata.*—Damping off of seedlings of *Cedrela serrata* was reported from an estate. The diseased seedlings invariably yielded a *Fusarium* sp.

Fig. 2. Soil Moisture at Two Depths in Shaded and Unshaded Tea.



(*iii*) *Coffea robusta*.—Yellowing of the leaves, wilting and death of coffee plants were reported from an estate. An examination of the aerial parts did not reveal any pathogenic organism, but the roots showed a discolouration of the wood suggestive of a vascular disease. On plating out, the diseased roots yielded a *Fusarium*. Liming the 'Fusarium-sick' soil was suggested as a remedial measure.

The fungus grew well on potato-dextrose agar turning it reddish purple in colour. The macroconidia were sickle-shaped and hyaline, the number of septa varying from 1 to 6, although the usual number was 3. The microconidia were ellipsoidal and non-septate. The macro- and micro-conidial sizes were generally within the range given for *Fusarium bulbigenum* var. *coffeae* recorded by Garcia. It was, however, recognized that more careful and exhaustive studies were necessary for confirmation of the identification.

(*iv*) *Hevea brasiliensis*.—A stem disease of Hevea rubber was reported from an estate in Travancore. The symptoms exhibited by the affected branches largely corresponded with those of the White Thread Blight recorded by Sharples. The perfect stage of the fungus was not seen. This fungus was also reported to spread to tea on the same estate. Further details of this fungus have been given in an earlier part of this report.

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